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Destruction of Moth Bean (*Vigna aconitifolia* (Jacq.) Marechal) Morphological Aspect and Biochemical Constituents During Dairy Effluent Irrigation

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Abstract **Original Research Article**

The current exploration is being fetched out to evaluate the consequence of dairy effluent on morphological aspect and biochemical constituents in Moth bean (*Vigna aconitifolia* (Jacq.) Marechal). For this, experimentation work dairy effluents were amassed from the outlet of milk processing plants. The diverse concentrations used for the effluent were Control (normal water), 5, 25, 50, 75 and 100%. The growth parameters *viz.*, shoot length (SL), roots length (RL), number of leaves (NL), total leaf area (TLA), fresh weight (FW) and dry weight (DW), and the biochemical issue like *viz.*, chlorophyll 'a', chlorophyll 'b', total chlorophyll, carotenoid, reducing, non-reducing sugar, total sugars, starch, amino acid, and protein content were analysed and tabulated at 30th days after sowing (DAS). As stated by the investigational results obtained all the morphological strictures, biochemical elements, were establishing to enhance at 5% concentrations of dairy effluent and drop off in 50% effluent concentration. So these outcomes imitate that the dairy effluent is noxious nature to moth bean. Thus the dairy effluent is exceptionally alkaline in environment and contains gigantic amounts of suspended solids and dissolved solids consequent in soaring of BOD and COD and other enormous chemical constituents.

Keywords: Dairy effluent, Moth bean, Physico-chemical, Morphological aspect and Biochemical constituents.

INTRODUCTION

The availability and excellence of water resources are known to be significant factors for the sustainable expansion of any country and the normal health conditions of its population. Countless of water bodies in Tamil Nadu are deteriorating as natural self-cleaning progression cannot cope with the pollution they receive. As a result, water eminence in many reservoirs beforehand used for drinking water supply has now dropped to third class. This practice is mainly caused by the massive discharge of untreated or poorly treated wastewater, and every effort should be made to reduce this misconduct.

Assorted of food processing facilities are extensively disseminated in Tamil Nadu and their wastewater treatment equipment is often especially old and worn, resulting in water sanitization technologies malfunctioning. Barring, food industrial units are often fitted with wastewater treatment lines designed for public (municipal) wastewater, which does not always ensure the necessary cleaning of industrial wastewater (Chobsan and Winkler 2013).

In India, dairy industry is solitary of the majority indispensable agro-based industries and is main commodity entering trades. The dairy operations involve processing of uncooked milk into pasteurized and sour milk, durable, flexible and hut cheese cream and butter foodstuffs, ice cream, yoghurt, milk powders, condensed milk and diverse sort of last course for the consumer. Huge sum of aqua is wieldy in assorted stages of dairy operations, such as, milk processing, cleaning, packaging and cleaning of the milk tankers and ensuing in invention of notable extent of waste water which is known as dairy effluent (Milani et al., 2011;Manu et al., 2012).

Since milk is exceedingly perishable, it is a crucial community strength and cost-effective concept to supply consumers with a first-class quality, clean, product free of pathogenic bacteria. To sustain quality standards, quality control measures must be taken at all stage of milk production, including sanitary conditions at the milking parlor, as well as handling, processing and packaging of milk on storage, transport and reception vessels. Rustic region were recognized for milk fabrication, metropolis core were collected for the location of dairy bout plants and invention manufacturing plants. The number of dairy and associated industries is rising piercingly as swift industrialization is captivating place across the country.

In Tamil Nadu is 'Ten States' in milk fabrication in the nation with daily milk making of 223 lakh liters. Out of this approximately 38 lakh litters per day (LLPD) is retain for household utilization and almost 32 % is i.e. around 71 LLPD is being produced by the prearranged segments such as collective and personal dairies. The allocate of collaborative in overall milk production in the state is around i.e. 16% 37LLPD.TamilNadu has moved to the lead to third place from the earlier fourth place among the state Co-operative in milk obtaining in Tamil Nadu state thereby to augment the milk fabrication of Tamil Nadu, which is a nutritionally affluent food to assemble the daily wishes of all universal civic irrespective of age and religion.

In the state of Tamil Nadu there are 9,988 village-level primary milk producers Co-operative Societies (MPCS) having 20.21 lakh members in Co-operative ambit. Milk producers Co-operative societies work all 365 days without any holiday and are procuring milk both in the morning and evening from the milk pouring members and are having direct contact with the members daily which enables the societies to resolve the grievances of members early.

The mass of dairy waste water released by milk handing out plant be contingent on the volume of the plant, commonly expressed in terms of the utmost load of milk maneuver in single daylight hours, and the processes involved. The dairy diligence generate on a normaly 6-10 L of misuse hose per 1L of the milk operation. It has comparatively towering organic matter, suspended solids, trace organics nutrients, inorganic nutrients which are essential for enlargement of crop plants (Kharbanda and Prasana, 2016; Verma and Singh, 2017).

In general dairy waste enclosed bulky extent of milk constituents such as casein, lactose, fat, inorganic salts, besides and sanitizers which contribute predominantly towards towering BOD and COD (Britz et al., 2006; Goel et al., 2017). The elevated value of suspended solids and dissolved solids, show its high pollution potential. Liberation of such dissipate into inland surface water will lead to attenuation of O_2 in the reservoir, disturbing aquatic life and generating unaesthetic anaerobic conditions. Since dairy squander water streams restrain elevated concentration of organic matter, these effluents may cause consequential evils in terms of organic stack (Kolev slavov 2017). The tainting water is being used for irrigation by nearby farmers. It is indispensable to academic work the consequences of this effluent on crop system before they are endorse for tillage irrigation. So the attendance exploration was carried out to study the effectual and appropriate concentrations of dairy effluent in promoting morphological and biochemical constituents of Moth bean (Vigna aconitifolia (Jacq.) Marechal).

MATERIALS AND METHODS

Materials

Seed collection

Moth bean (Vigna aconitifolia (Jacq.) Marechal) be the possession of the family Fabaceae, customarily husbandry in arid and semiarid province of India. V. aconitifolia is an obscure legume seeds is inhabitant to India and Pakistan, vegetation for food construction and as a comestibles and cover crop. The crop is extensively cultivated in the Tamil Nadu. So the seed samples were collected from Agricultural Department (Seed section), Dharmapuri District, Tamilnadu.

Effluent collection

The dairy effluent tasters were equanimous in plastic repository from the egress of Milk Processing Center (MPC), Dharmapuri, Dharmapuri District. They were without delay brings to the laboratory for the analyses of physio-chemical assets as per the technique mentioned in American Public Health Association (APHA, 1995).

Methods

Experimental Design and Details

The investigational intend and information is as follows:
Cultivar- Moth bean (Vigna aconitifolia (Jacq.) Marechal)
No. of behaviors - 6
Sampling day - 30

Behaviors niceties

The conduct particulars are as trail
T_1 - Control (Water)
T_2 - 5 per cent effluent
T_3 - 25 per cent effluent
T_4 - 50 per cent effluent
T_5 - 75 per cent effluent
T_6 - 100 per cent effluent

Farming Details

Soil

Seeds were grown in pots, the pots containing garden soil, red soil, and sand in the ratio of 1: 2: 1.

Seed Sowing

Each pot enclosed 3 kg of air desiccated soil. Ten seeds were sown in every pot. All pots were the diverse action of effluents to irrigation capacity daily. Both actions including the control were replicated six times.

Shoot Length

The plant shoot length was deliberated from the point of earliest cotyledon node to the tip of the extensive leaf and the mean values were expressed in cm.

Root Length

The plant root length was premeditated from the position of opening cotyledon node to the tip of the lengthy root and the mean values were expressed in cm.

Number of Leaves

The total numeral of leaves in each plant was counted at 30th DAS growth phases and articulated as numeral of leaves per plant.

Leaf area (cm^2 plant^{-1})

The leaf area was deliberated by assessing the length and breadth and multiplied by a correlation factor (0.69), consequential from the method of Kalra and Dhiman (1977).

Ascertainment of Fresh Weight

The sprouts were plugged after 30th DAS without any damage. Behind wash, plant weights were determined by using an electronic balance.

Ascertainment of Dry Weight

The sprouts were uprooted on the 30th DAS and washed with water. Then they were dried at 80°C in hot air oven for 24 hrs. After drying plant weights were deliberated in an electronic balance.

Biochemical psychiatry

The photosynthetic pigments such as chlorophyll a, b, total chlorophyll (Arnon 1949) and carotenoid (Kirk and Allen, 1965) and the biochemical contents such as, amino acid (Moore and Stein, 1948) and sugars (Nelson, 1944), starch (Dubois et al., 1956) and protein (Lowry et al., 1951) were investigate in the investigational plants. The testing plants were randomly amassed at 30th DAS.

Statistical Investigation (Gomez and Gomez, 1984)

Statistical investigation was execute by means of two ways analysis of variance (ANOVA) trailed by Duncans multiple range test (DMRT). P values $\leq$ 0.05 were considered as significant.

RESULTS AND DISCUSSION

Physico-Chemical Assets of Dairy Effluent

The physico-chemical differential of dairy effluent with liberality restrictions standards are specified in (Table 1). The dairy effluent was milky in colour and pH (8-8.5) in nature. Electrical conductivity of the effluent was (2750 μhos/cm) it enclose elevated amount of total suspended solids (700 mg/l) and total dissolved solids (840 mg/l). The biological oxygen demand of the effluent was (1002 mg/l) and chemical oxygen demand (1590 mg/l). In addition to that a substantial amount of calcium (151 ppm), sodium (389 mg/l), chloride (448 mg/l), nitrate (59 mg/l), sulphate (118 mg/l), potassium (53 mg/l), the towering amount of total hardness (530 mg/l) and alkalinity (660 mg/l) in addition to the oil and grease (0.088 mg/l) were also present in the dairy effluent.

Table-1: Physico-chemical investigation of dairy effluent

S. No.	Parameters		Amount
1.	Colour	-	Milky
2.	Odour	-	Disagreeable
3.	PH	-	8.5
4.	EC	-	2750 hos/cm
5.	TSS	-	700 mg/L
6.	TDS	-	840 mg/L
7.	BOD	-	1002 mg/L
8.	COD	-	1590 mg/L
9.	Oil and Grease	-	0.088 mg/L
10.	Alkalinity	-	660 mg/L
11.	Total hardness	-	530 mg/L
12.	Calcium	-	151 ppm
13.	Potassium	-	53 ppm
14.	Sodium	-	389 mg/L
15.	Sulphate	-	118 mg/L
16.	Nitrate	-	59 mg/L
17.	Phosphate	-	28 mg/L
18.	Chloride	-	448 mg/L
19.	Magnesium	-	53 mg/L

The waste water analysis was carried out by APHA (1995) method

All parameters except colour, pH, EC, temperature are expressed in mg/l

From the effluent testing it is concluded that free CO_2 in the water is partly responsible for the augmented or preliminary pH reading, the total solids are sum of the worth of the total dissolved solids and that suspended solids. The solid varies in extent to temperature and is inversely proportional to the water level. High concentration of total solids during summer was probably due to squat quantity of water. In effluent, total solids, total dissolved solids; total suspended solids are encompassing mainly of carbonates, bicarbonates, chlorides, sulphate, phosphate, nitrate and organic matter (Tikariha and Sahu 2014; Nabbou et al., 2020). Chlorides are conventionally there in natural water. The existence of chloride in the ordinary water can be devolving to termination of salts sediments discharged of effluent. The total hardness of water was noticed as 530 g/l. Hardness is defined as the concentration of calcium and magnesium ions content of effluent (Verma and Singh 2017).

Pot Culture Experiment

Pot culture experiments were behavior to find out the morphological and biochemical considerations amend of moth bean grown under diverse concentration of dairy effluent.

Shoot Length and Root Length (cm/plant)

The reactions of assorted application of dairy effluent on morphological charters of moth bean at various stages of growth given in (Tables.2). The premier shoot length (23.6 cm/plant), root length (13.9cm/plant), fresh weight (15.90 mg/fr.wt), dry weight (6.20 mg/dr.wt), Number of leaves (19.6), Leaf area (16.5 cm^2 $plant^{-1}$), at 30th DAS was experiential in 5 per cent concentration of dairy effluent. The least range of shoot length (9 cm/plant), root length (3.6cm/plant), fresh weight (2.30 mg/fr.wt), dry weight (0.78 mg/dr.wt), Number of leaves (4.0), Leaf area (3.95 cm^2 $plant^{-1}$) 30th DAS was noted in 100 per cent concentration of dairy effluent. F-test values for the difference between dairy effluent concentrations, sampling days and interaction between effluent levels and sampling days were significant at 1% level.

Tabe-2: Effect of dairy effluent on the morphological and pigment content of moth bean (Vigna aconitifolia (Jacq.) Marechal).

	Biochemical Parameters (30 DAS)						
	Carotenoid (mg/g fr. wt.)	**Reducing Sugar (mg g^{-1} fr. wt)**	**Non-Reducing sugar (mg g^{-1} fr. wt)**	**Total sugars (mg g^{-1} fr. wt)**	**Starch (mg g^{-1} fr. wt)**	**Amino acid (mg g^{-1} fr. wt)**	**Protein (mg g^{-1} fr. wt)**
Control	0.658^a ± 0.023	2.98^a ±0.15	4.96^a ±0.25	7.94^a ± 0.39	13.9^a ± 0.75	7.1^a ± 0.35	8.86^a ± 0.44
5% Effluent	0.781^b ± 0.027	4.40^b ±0.22	6.21^b ±0.31	10.61^b ± 0.51	16.3^b ± 0.81	9.6^b ± 0.45	13.40^b ± 0.67
25% Effluent	0.703^c ± 0.022	2.13^c ±0.11	4.28^c ±0.21	6.41^c ± 0.32	9.8^c ± 0.49	6.75^c ± 0.33	7.87^c ± 0.39
50% Effluent	0.451^d ± 0.018	1.80^d ±0.09	3.78^d ±0.19	5.58^d ± 0.29	7.3^d ± 0.39	5.18^d ± 0.25	5.65^d ± 0.28
75% Effluent	0.328^e ± 0.010	1.25^e ±0.06	3.12^e ±0.16	4.37^e ± 0.24	5.9^e ± 0.29	3.89^e ± 0.19	3.97^e ± 0.19
100% Effluent	0.222^f ± 0.008	0.89^f ±0.04	1.53^f ±0.07	2.42^f ± 0.11	3.4^f ± 0.17	1.85^f ± 0.09	2.23^f ± 0.11

Average of five replication, and ± Standard deviation

Values, that are not sharing common superscript (a, b, c, d, e, f) differ significantly at $P \leq 0.05$ (DMRT).

The growth of moth bean seedlings augmented 5 per cent concentrations of dairy effluent. The consequence obtained from the pots treated with 5% effluent concentrations was consistently enhanced as differentiate to other treatments. However, the growth of the seedlings was drastically inhibited in elevated concentrations of the dairy effluent (Gaikar et al., 2010).

It indicates that the 5% concentrations of dairy effluent had a noticeable encourage the overall growth of moth bean seedlings. For these reasons, the seed might have indispensable a few nutrients for their prevalent metabolic tricks. The effluent also conquers plant nutrients and trace elements, which are exploiting for the enhanced growth of moth bean roots. The elevated concentrations (above 25%) of effluent condensed the growth of seedlings. It seems that these concentrations of the effluent hold a surplus of total nitrogen, phosphate, potassium, calcium, chloride and sulphate which are injurious to plant growth by distressing the water absorption and other metabolic processes of the moth bean plant. The diluted dairy effluent might have the optimal concentration of the assorted nutrients required for sublime enlargement of root and shoot formation.

Total leaf area, seedling fresh and dry weights also ameliorate at 5% dairy effluent and diminished at above 25% of effluent. The exorbitant concentrations of dairy effluent deplete the numeral of branches of moth bean plants and decline in phytomass accumulation under the effluent stress have been recognized by diverse workers (Dhanam 2009; Manu et al., 2012; David Noel and Rajan, 2015; Gupta et al., 2016; Ain et al., 2019; Palanisamy et al., 2020). The increased leaf area and weights of the plant can be due to inclusion and translocation of the N, Ca, Na and Cl from the effluent (Vijayaragavan et al., 2011; Hailu et al., 2019).

The chlorophyll is a fundamental constituent of plant pigments and acting as vital role in the route of photosynthesis. It is the molecules that absorbs sunlight and exploit its energy to synthesis carbohydrates from CO_2 and water. It also simulates a key task in ATP synthesis. Table 3 represented that biochemical content of moth bean, the maximal chlorophyll 'a'(1.10 mg g^{-1} fr. wt.), chlorophyll 'b' (0.83 mg g^{-1} fr. wt.), total chlorophyll (1.84 mg g^{-1} fr. wt.), carotinoid (0.781 mg g^{-1} fr. wt.), reducing sugar (4.40 mg g^{-1} fr. wt.), non-reducing sugar (6.21 mg g^{-1} fr. wt.), total sugars (10.61 mg g^{-1} fr. wt.), starch (16.3 mg g^{-1} fr. wt.), aminoacid (9.6 mg g^{-1} fr. wt.) and protein (13.40 mg g^{-1} fr. wt.) at 30th DAS was observed in 5 per cent concentration of dairy effluent. The minimum range of chlorophyll 'a'(0.31 mg g^{-1} fr. wt.), chlorophyll 'b' (0.24 mg g^{-1} fr. wt.), total chlorophyll (0.55 mg g^{-1} fr. wt.), carotinoid (0.222 mg g^{-1} fr. wt.), reducing sugar (0.89 mg g^{-1} fr. wt.), non-reducing sugar (1.53 mg g^{-1} fr. wt.), total sugars (2.42 mg g^{-1} fr. wt.), starch(3.4 mg g^{-1} fr. wt.), aminoacid (1.85 mg g^{-1} fr. wt.) and protein(2.23 mg g^{-1} fr. wt.) 30th DAS was noted in 100 per cent concentration of dairy effluent. F-test values for the difference between dairy effluent concentrations, sampling days and interaction between effluent levels and sampling days were significant at 1% level.

Tabe-3: Effect of dairy effluent on the Biochemical content of moth bean (Vigna aconitifolia (Jacq.) Marechal).

	Biochemical Parameters (30 DAS)						
	Carotenoid (mg/g fr. wt.)	**Reducing Sugar (mg g^{-1} fr. wt)**	**Non-Reducing sugar (mg g^{-1} fr. wt)**	**Total sugars (mg g^{-1} fr. wt)**	**Starch (mg g^{-1} fr. wt)**	**Amino acid (mg g^{-1} fr. wt)**	**Protein (mg g^{-1} fr. wt)**
Control	0.658^a ± 0.023	2.98^a ±0.15	4.96^a ±0.25	7.94^a ± 0.39	13.9^a ± 0.75	7.1^a ± 0.35	8.86^a ± 0.44
5% Effluent	0.781^b ± 0.027	4.40^b ±0.22	6.21^b ±0.31	10.61^b ± 0.51	16.3^b ± 0.81	9.6^b ± 0.45	13.40^b ± 0.67
25% Effluent	0.703^c ± 0.022	2.13^c ±0.11	4.28^c ±0.21	6.41^c ± 0.32	9.8^c ± 0.49	6.75^c ± 0.33	7.87^c ± 0.39
50% Effluent	0.451^d ± 0.018	1.80^d ±0.09	3.78^d ±0.19	5.58^d ± 0.29	7.3^d ± 0.39	5.18^d ± 0.25	5.65^d ± 0.28
75% Effluent	0.328^e ± 0.010	1.25^e ±0.06	3.12^e ±0.16	4.37^e ± 0.24	5.9^e ± 0.29	3.89^e ± 0.19	3.97^e ± 0.19
100% Effluent	0.222^f ± 0.008	0.89^f ±0.04	1.53^f ±0.07	2.42^f ± 0.11	3.4^f ± 0.17	1.85^f ± 0.09	2.23^f ± 0.11

Average of five replication, and ± Standard deviation

Values, that are not sharing common superscript (a,b,c,d,e,f) differ significantly at $P \leq 0.05$ (DMRT).

The expanding in the chlorophyll content at 5% concentration of the dairy effluent treated plants. It might be due to the constructive effects of Nitrogen and other elements which are grant in their optimum quantities and the effluent contains of 'Mg' and 'K' and other trace prerequisites elements in the 5% concentration of the dairy effluent. Among the elements are required for biosynthesis of pigments (Krishna and Leelavathi, 2002). The augment in sugars and starch content of moth bean seedlings were documentation at 5 per cent concentration of dairy effluent (Table 3). The sugar content drop off at elevated concentration of the dairy effluent. The sugars content proved declined tendency in towering concentrations of the dairy effluent. The consequence may be due to transportation of most of the nitrate and nitrite engrossed by the plants. An auxiliary vision the decline of sugar content at soaring concentration of the effluent might be due to the extreme nutrients lay hold of that caused polarity and ultimately cut to depletion of carbohydrate reserve (Thamizhiniyan et al., 2000; Lal 2009; Vijayaragavan et al., 2011).

Expand the amount of sugars and starch might be either due to diffidence in starch synthesis from hexose or stimulus of starch hydrolysis. The condensed amount of sugar in the plants dealing with elevated concentrations of the effluent might be due to the exploitation of the sugars in metabolic activity in regulate congregate stress situation, too the decreasing sugar content (Dhanam 2009). Decrease in amino acid content due to towering of salinity at towering concentrations can be allocated to the resist ramification of the effluent on protease activity (Gupta et al., 2016). The augmented the protein content of moth bean. It might also be accredited to extensive integration and assimilation of Potassium and Nitrogen, which co-operate a crucial perform in protein synthesis in plant metabolism. Enhance in the protein content of moth bean plant might be due to the micro and macro nutrients essential for plants in their most constructive extent there in the lesser concentration of the effluent (Thamizhiniyan et al., 2009).

CONCLUSION

To end with the article fulfilled that with results the elevated concentration (above 25%) of dairy effluent perform as a stress at the same time the lesser concentration (5%) of dairy effluent augment the plant morphological and biochemical activity, by means of presence of required quantity of micro and macro nutrients here in lesser concentration of dairy effluent. Because of the availability of these nutrients the effluents suggest a possibility to utilize them for irrigation after proper treatment or dilution.

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